White Paper

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Project Director: Christine Wiseman

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Project Director: Christopher Davidson, State Archivist

Institution: Georgia Archives-Board of Regents of the University System of Georgia

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White Paper
NEH Grant PF-50274-12
Preservation and Access
Sustaining Cultural Heritage Collections

Sustainable Georgia's Historical Records

Georgia Archives
Board of Regents of the University System of Georgia
Morrow, Georgia

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Kim Norman, Project Manager
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December 30, 2016

PROJECT OVERVIEW

In 2011, the Georgia Archives was awarded a Sustaining Cultural Heritage Collections Implementation Grant of $122,147 from the National Endowment for the Humanities to expand upon energy saving measures initiated between 2008-2010. This project was proposed for updating and further automating the heating ventilation air conditioning system (HVAC), updating lighting in building areas affecting original material (including exhibit areas, treatment labs, and the original documents reading room), as well as recommissioning the HVAC system.

The fundamental goals of the project were to expand upon energy saving efforts established by the Archives staff, continue to maintain a preservation environment that provides the best possible conditions for the permanent storage of the State historical records with the least possible consumption of energy, while gathering data that would be of use to other cultural organizations undertaking similar projects. Because these efforts were initiated before 2009, the Georgia Archives was in the unique position to serve as a model to other organizations striving for sustainable stewardship while balancing pressures to reduce facility energy usage. Through national conferences, building tours, regional presentations, and local workshops, Georgia Archives staff widely disseminated the results of this project to help other organizations create sustainable environments for their collections.

SIGNIFICANCE

As the state archives of Georgia and one of the original thirteen colonies, the Georgia Archives holds a rich collection of colonial and state records covering nearly three centuries. Holdings include local government records, maps, photographs, and private collections that complement the official records. Of the 90,000 cubic feet of records in the Georgia Archives, approximately 75,000 are official state records, 6,000 are local government records, and 9,000 are non-governmental. The vast majority of these are unpublished, original source materials in their original format.

The Georgia Archives supports significant historical research on the colonial period, a unique slice of American history. Georgia was the only colony to be governed first by Trustees and then as a royal colony. Records from this period include the 1732 Royal Charter, the Transactions of the Trustees of Georgia, and lists of original colonists/grantees (1733). The Transactions of the Trustees, in particular, are useful for documenting Georgia as a unique colonial experiment. It should not be surprising that records of the oldest state offices in Georgia are among the most heavily used by researchers. Georgia governors left a large quantity of records documenting state affairs, correspondence of governors, executive minutes, proclamations, and treaties. House and Senate Journals along with Acts and Resolutions are other important resources in our collections. They are single series that run unbroken for centuries to the present day.

PRESERVATION CHALLENGE

Preservation of the Georgia government permanent records is integral to the mission of the Georgia Archives. Preservation and conservation activities at this institution date back to the 1940s when the Georgia Archives began microfilming records held by the Archives and also from counties around the state. This was one of the earlier microfilming initiatives in the US, which thrived long before standards for preservation filming were developed and continued up until the late 1990s.

The Archives staff began monitoring the environmental conditions in the new building upon its opening, first with analog hygrothermographs. In addition, a Honeywell control system collected and displayed data from numerous temperature and relative humidity sensors throughout the building and HVAC system. It soon became necessary for preservation staff to conduct additional monitoring independent of the outdated control system. There were numerous instances when problems were discovered with the system due to independent monitoring, such as when preservation staff detected increases in humidity that were later attributed to moisture penetrating the brick façade. In 2006, the Archives incorporated two PEM data loggers into its monitoring program, and in 2007, six more PEMs were purchased. The older data loggers were relegated as back-ups for extended spot monitoring. Data was gathered and downloaded biweekly from the four storage vaults, high security vault, reference library, scanning area, and conservation labs. To date, there are now twelve PEM monitors working to collect environmental data throughout the building.

In 2011, it became necessary for staff to download data as frequently as weekly when the HVAC system was malfunctioning or if a problem was suspected. Currently, we have ten years of continuous data in Image Permanence Institute (IPI) and *eClimate Notebook* software. As of February 2011, all data collected by data loggers since 2005 was migrated to the IPI online data analysis application, www.PEMdata.org. In 2011, IPI used the Georgia Archives environmental data in a webinar entitled *Managing the Storage Environment in the Southeast Region*, and the recording of the webinar has been available online since then (http://ipisustainability.org/?page_id=227).

BUILDING DESCRIPTION

When the Georgia Archives opened its doors in 2003 to the public, it was the fourth facility since its inception in 1918. The building is currently located in Morrow, Georgia about twelve miles south of Atlanta and next to the National Archives (NARA) Southeastern Branch. Construction of this state-of-the art, 171,000 square-foot building formed a unique partnership with state and federal government officials. Design of the building began in 2000 with the highest priority placed on building an archival facility that met current standards for providing a high level of security and environmental protection of the state records.

The records storage vaults are a four-story poured concrete structure with the three-story office and work areas wrapping around the vaults in an L-shaped manner. The Archives has a separate high-security vault, housing treasures of the collection and protected by extra security measures as well as a separate FM-200 fire suppression system. Presently, there are more than 90,000 cubic feet of records housed in the building with enough space for many years of future growth.

Illumination in the vaults in provided by overhead LED lamps and fixtures, which replaced the original fluorescent bulbs through the NEH grant. Vault lights are connected to the Archives card access system and illuminate only when someone enters or exits a vault, minimizing efficiency of electricity usage and damaging light exposure. The combination of lighting in the reading rooms now includes a combination of LED canned lighting and LED lights recessed into ceiling soffits. These lights were selected because of minimal UV output, proven to be extremely efficient to run, inexpensive to replace, and greatly reduced damage potential to original items.

The Georgia Archives building mechanical system is a complex, multi-zoned, constant air, and variable volume HVAC system with eight air handlers, two chillers, and two desiccant dehumidification systems to combat fluctuating high humidity prevalent in the Southeast. With the preservation of the collections as the top design priority, building specifications required in 2003 that the four vaults provide conditions of 60 F (+/-5) and a relative humidity of 35% (+ /- 3%). The constant air volume (CAV) systems for the vaults were designed to take in 100% outside air and run at full fan speed 24-hours per day, 365 days per year. There were two 240-ton Trane Chillers designed to run at 38 F in order to maintain constant low temperatures in the vaults. The system was, in fact, able to meet these strict design specifications, even during the summer when outdoor air temperatures average well over 90 F, relative humidity levels consistently reach above 80%, and the dew point regularly reaches 70 F *(See Charts 1 and 2.)*.

Each of the four storage vaults has a dedicated air handling unit (AHU) serving the space that processes between 15,000 and 22,000 cubic feet of air per minute (cfm). These systems have chilled and hot water coils, desiccant wheels, a reactivation fan, and two gas-burner drying units. Some dehumidification is achieved through re-heat; however, it is supplemented by two stand-alone desiccant dehumidifiers. They used to operate on constant volume with design specifications based upon very humid conditions. In Atlanta, the relative humidity varies significantly, making it difficult to control the amount of dehumidification when outdoor conditions are dry.

Chart 1: Temp and RH Levels in 3rd Floor Vault, Apr – Sept 2011

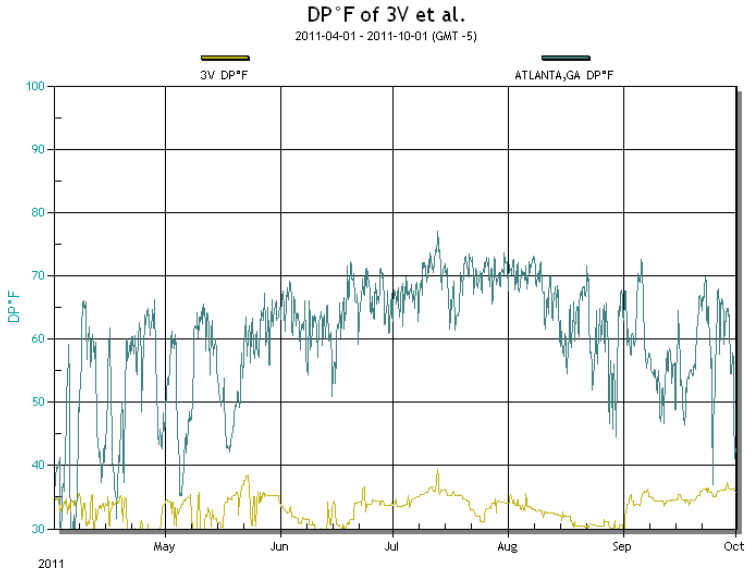
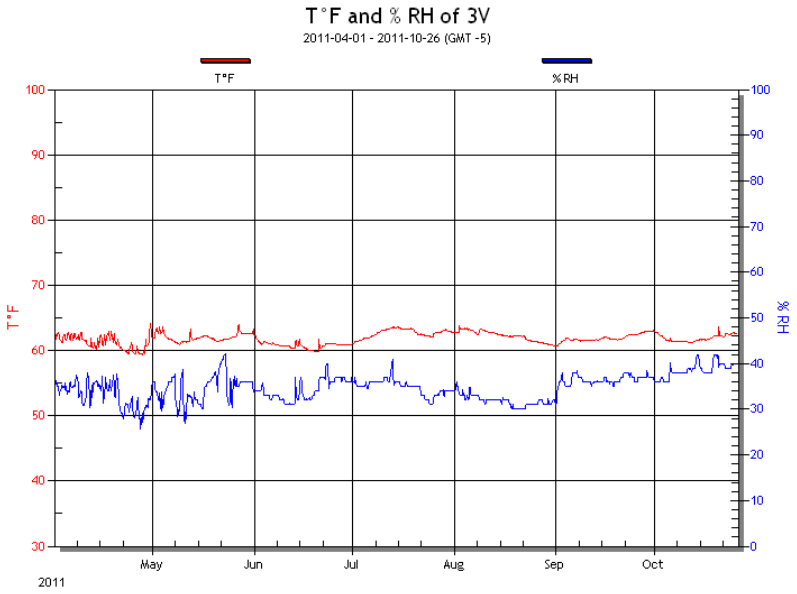


Chart 2: Indoor/Outdoor Dew Point Comparison: Apr – Sept 2011



Ironically, the Georgia Archives occasionally had problems with over-dehumidification, impacting conservation work (dry conditions make it difficult to work with adhesives) and resulting in unnecessarily high utility expenses. During the winter, the operation of the steam boiler for humidification is controlled by sensors in the vaults. The lower RH set points for the vaults would disengage the steam boiler, causing the relative humidity levels to drop below acceptable levels in other collection work areas, such as the conservation lab, scanning labs, and exhibit areas.

A constant air volume (CAV) AHU serves the conservation and reformatting laboratories, processing rooms, and reference library. It is important to note that the fan speeds of the five CAV air handlers could not be adjusted; they were either on or off, resulting in tremendous energy usage and high maintenance costs. Three additional AHU's with variable frequency drives were on a PIU (primary induction unit) that served the perimeter areas and office spaces in the building. Since these units had variable frequency drives, the fan speed could be adjusted and regulated in order to meet the varying indoor climate preferences of staff.

The Georgia Archives mechanical system provides environmental conditions for the collections that meet recommended standards for the long term preservation of archival collections. In 2011, it had become extremely difficult to economize the functioning of this system. The result was substantial, often unnecessary energy consumption and excessive costs, both monetarily and environmentally. For example, the original design was intended to run the dehumidifier and the steam boiler simultaneously, extremely costly in terms of energy usage. (This has been necessary on occasion.)

Between 2008-2011 and largely in response to budget cuts, the Archives was able to reduce monthly electricity usage 21% and gas usage by 44% through manual manipulation of the HVAC system. The lack of automation, though, was compounded by the fact that the computer control system was nearly ten years old at that time and operated via a Microsoft Windows 2000 platform. This made control manipulations slow and difficult, especially from remote locations. At the time the building was constructed, *sustainability was not a primary concern*. Dehumidification and constant volume were the principal design objectives of the system.

When the building was designed and constructed in the early 2000s, operating costs were considered secondary to optimal environmental conditions. Although the facility was able to provide optimal conditions for the preservation of the collections, the operating costs were exceedingly high as electric and gas rates continued to climb. For the future of the Archives, our challenge was to reduce energy usage while continuing to be responsible stewards of the state permanent records in Georgia.

HISTORY OF THE PROJECT

Even before the recession hit in 2007-2008, Archives administrators saw the need to reduce building operating costs. The cost per kilowatt hour (kWh) for electricity had increased by nearly 30% between 2005 and 2011. The need became critical in 2009 after another large state budget cut. At that time, a group of staff members was already meeting monthly to review environmental monitoring data, but as the budget tightened and pressure increased to further reduce costs, the environmental management team expanded to include four staff members: Assistant Director for Operations, Conservator, Preservation Services Manager, and Assistant Director for Archival Services. Meetings were held more frequently as members reviewed biweekly environmental data.

Archives staff reported on repairs and maintenance issues affecting the function of the system, and the team began to strategize for ways to maximize energy savings**.** Early measures of reducing overall energy costs included lowering the amount of outside air coming into the building, shutting down or reducing the use of the air handlers supplying the non-collection storage areas, and slightly raising overall set points on temperature and humidity levels in the vaults. Temperature set points were adjusted during the summer from 60 to 65 F (+/- 5 F), and relative humidity level targets were raised from 35% to 40% (+/- 3%). During the winter, adjustments reverted back to the original, more stringent set points due to milder weather. Moreover, staff initiated a project to replace expensive fluorescent lamps in light fixtures throughout the entire building.

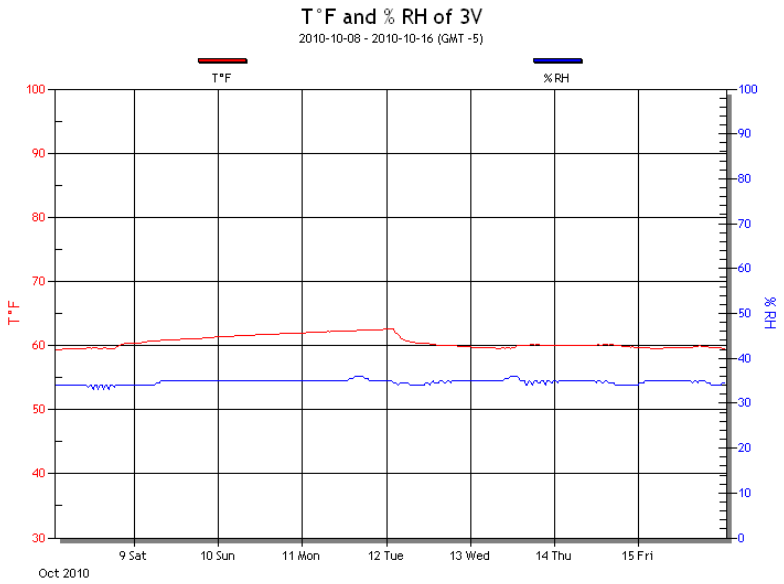
During the late summer of 2010, the Archives considered and tested controlled mechanical shut-downs of the air handlers in the vaults. This was done on weekends and evenings, especially leading into the fall and winter months to take advantage of lower outdoor temperatures. Making such a radical step, contrary to educational information and professional advice of the previous 20 years, was quite worrisome to preservation staff in the beginning.

The environmental management team drafted minimum and maximum temperature and relative humidity tolerance levels to alert key staff when the system required adjustment. Initial testing began by shutting down air handlers serving the four vaults, from Saturdays at 5:00 pm when the

reference room closed to the public until Tuesday morning when the building re-opened. During these early tests, staff would drive to the building and manually engage the air handlers if conditions exceeded (minimum or maximum) set points established by the environmental management team. The conservator performed weekly environmental monitoring.

Analysis tools in *eClimate Notebook* revealed that shutting-off equipment in the vaults over most of these 50-hour periods led to *only a slight increase* in temperature, less than 3 degrees (see *Chart 3*).

Chart 3: Temp and RH changes during a typical shutdown period of 3 nights

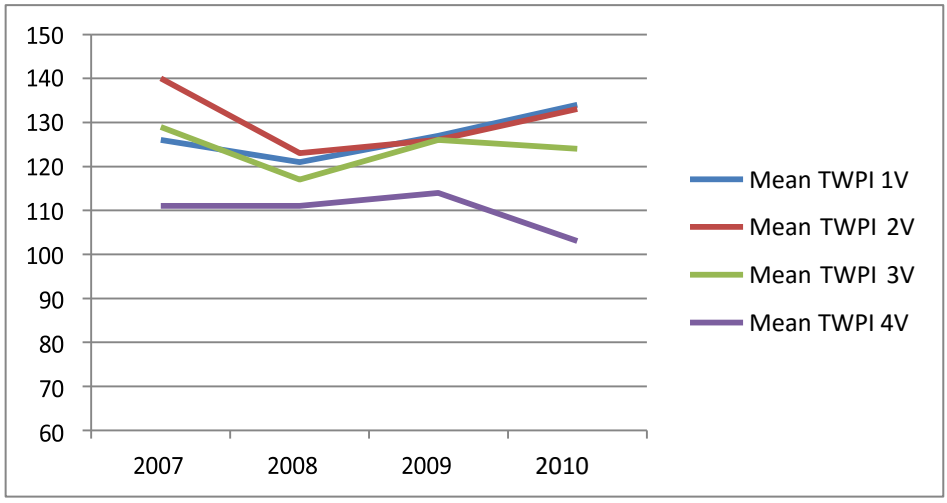


Little fluctuation in vault temperature was a direct result of a secure building envelope with a poured concrete structure. Changes in vault humidity levels during shut-downs were more dependent upon outdoor conditions. For example, when it was not raining, humidity generally held between 30 and 40%. The AHUs were engaged to maintain RH set points if rain was forecasted during shut-downs. The Time Weighted Preservation Index (TWPI) calculated in *eClimate Notebook* provided staff with proof that system shut-downs were not causing damage to the collections. Staff members of the Image Permanence Institute expressed surprised at these actions and findings, saying later that the Georgia Archives had been part of the professional avant garde in these ways.

Following several months of successful energy reduction measures, Archives staff began to consider testing additional HVAC shut-downs**.** We wanted to conduct them whenever the outdoor temperature dropped below 80 F for more than an hour, thereby saving energy during the cooler months. We also wanted to test overnight shut-downs when kilowatt rates were at peak cost; however, performing additional shut-downs was not possible without taking the next big step and automating our HVAC controls.

In the spring of 2010, the Archives administration approved the installation of controls that would allow staff to access the building control system remotely and change the vault AHUs using a computer and modem. This system, while outdated and running on an old Windows platform and a modem, saved staff from having to drive to the building to make such system changes during closed hours (nights, weekends, holidays, vacations). It did require an operator to be on-call all the time with access to a computer and the internet. IPI used a Time Weighted Preservation Index (TWPI) as the metric for comparing the quality of storage conditions over time. As controlled shut-downs continued during the 2010 calendar year, the TWPI in the collection storage areas only decreased by 1 or 2 points. *Chart 4* shows that the mean TWPI for all floors stayed above 100 from January 2007 through December 2010. IPI considered the environmental risk level of storage spaces with a TWPI above 100 to be excellent or low risk for rapid changing.

Chart 4: Mean Time Weighted Preservation Index (TWPI) Jan 2007 – Dec 2010



In February 2011, the Georgia Archives and the National Archives Southeastern Branch in Atlanta hosted a two-day workshop, *Sustainable Preservation Practices for Managing Storage Environments,* sponsored by the Image Permanence Institute and funded by the National Endowment for the Humanities. Over ninety attendees from around the Southeast participated in this seminar. It focused on new and slightly relaxed parameters for preserving collections while lowering energy and operating costs. As soon as the workshop began, Georgia Archives staff realized that they were already implementing and testing some of the techniques discussed in the workshop. The workshop helped to sanction our concerns and validate the testing of controlled shut-downs in an effort to reduce energy usage. This approach also provided for more relaxed temperature and RH set points as goals. We quickly realized how much further we had gone in our testing than many organizations and that the Georgia Archives could serve in this way as a model.

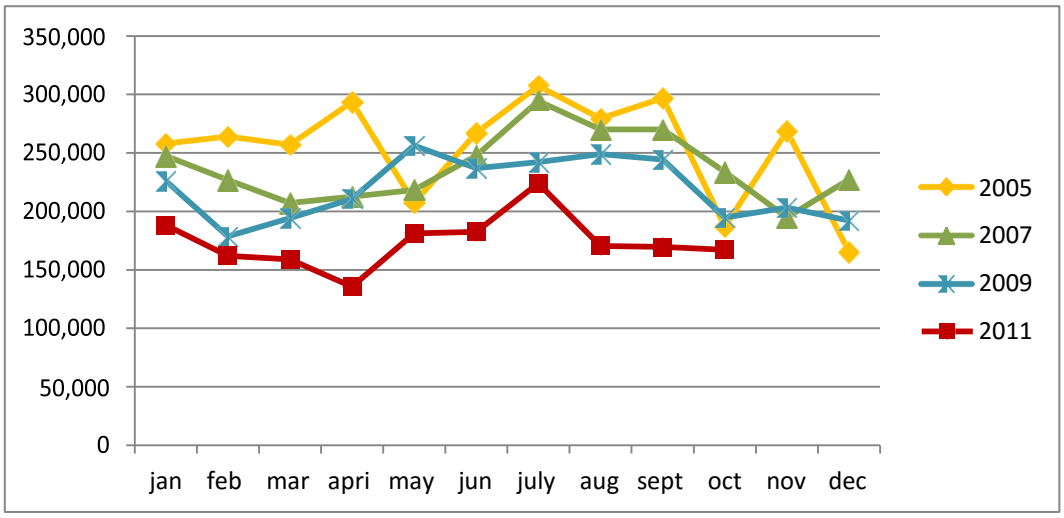
Following the 2011 seminar, Archives staff determined that running the AHU fans equaled 19% of an institution's annual energy costs. By installing variable frequency drives, the speed of the constant volume AHUs could be adjusted automatically. Knowing this, increased savings could be anticipated

due to the reduced energy required to power the fans in the future. Without further automation or mechanical changes, though, sustainability of these changes proved to be a daunting challenge. The Georgia Archives was fortunate to have a well-constructed and tight building envelope. During winter and fall months, planned shut-downs continued successfully. During rainy periods or the heat of the summer, system shut-downs of the vaults were not often possible or only for a few hours at a time. Manual adjustments proved labor intensive, impractical, and unsustainable.

Raising the temperature of the chilled water was another cost-saving measure implemented. The electric chillers contributed to a large portion of the Archives electrical consumption. The system was designed to run both 240-ton chillers, especially when the outside air temperature was above 80 F. One chiller ran all year long but with raised set points of the second chiller to start *only when the temperature rose above 92 F*, minimizing utility costs. Chiller set points were also raised from 38 F to between 42 and 50 F, cold enough to provide 60-65 F air in the vaults and further reduce kilowatt usage. In addition, increased condenser water temperature set points in the cooling towers from 75 F to 85 F saved electricity with no adverse effect to the collections storage areas.

As a result of these cost saving measures, the Archives reduced monthly electric bills on the average of 21% over that period of time. Since electric rates fluctuated, it was most informative to look at the trend in usage. *Chart 5* demonstrates that energy-saving measures were successful in lowering kWh usage between 2005 and 2011. For example, the usage was 296,700 kWh in September 2005, and it was 169,500 kWh in September 2011, a reduction of 43% over six years. Similar reductions occurred in other months, as well. In July 2011, usage quickly increased, but it should be noted that the summer of 2011 was the second hottest on record with 90 days over 90 F between May and September. (See http://www.srh.noaa.gov/ffc?n= summer2010)

Chart 5: Kilowatt hours per month by year

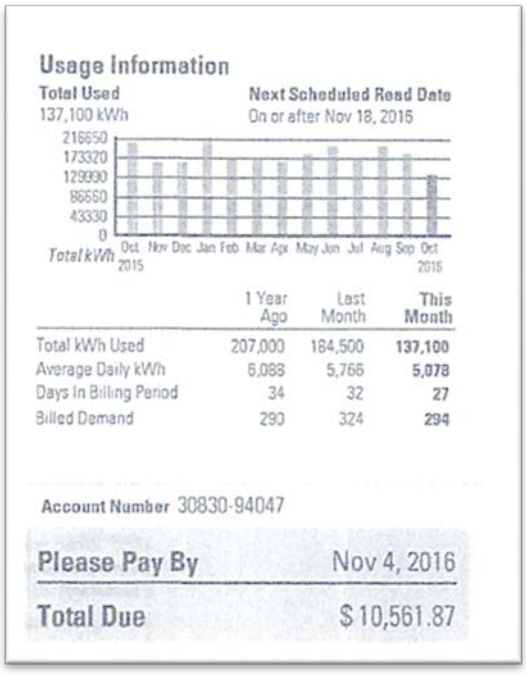


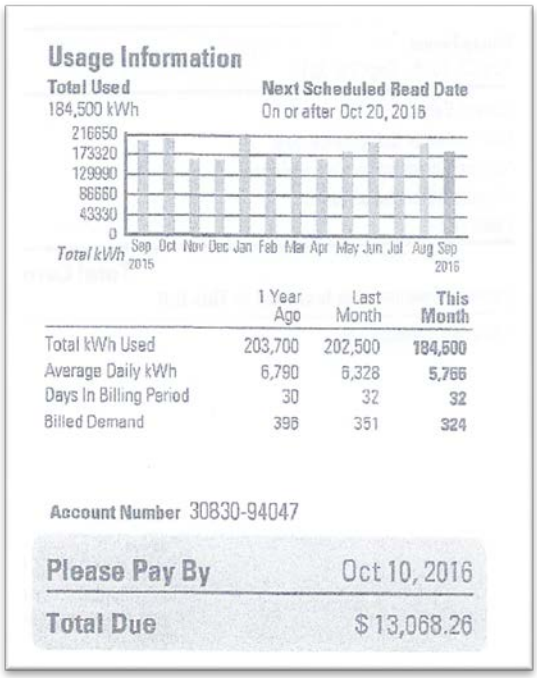
The HVAC automation portion of this grant project was installed unit-by-unit and became fully-programmed between June and July of 2016. In *Chart 6 and the two following images*, a marked decrease is seen when comparing monthly power use between 2015 and 2016. There is a significant decrease from 228,900 kWh in Aug 2015 to 202,500 kWh in Aug 2016. Averaging 7,153 kWh used per day in 2015, this decreased to 6,328 kWh per day in 2016.

Chart 6: Kilowatt hour usage comparison

kWh Usage:	2015	Daily	2016	Daily
August	228,900	7153	202,500	6328
September	203,700	6790	184,500	5766
October	207,000	6088	137,100	5078

Referring to 2011 data and seeing the recent improvements, adjustments to the control set points were made for chillers, cooling towers, AHU chilled water, and AHU hot water coils. Between Sept 2015 and Sept 2016, power usage decreased from 203,700 kWh in Sept 2015 to 184,500 kWh in Sept 2016. This equated to an average daily kWh decrease from 6,365 to 5,766.





With even further set point adjustments to steam, chillers, and air handlers, the next set of comparisons were made between Oct 2015 to Oct 2016. During this time frame, power usage had increased slightly to 207,000 kWh in Oct 2015, though the daily average was less. Within one year, usage dropped to a record low of 137,100 kWh in Oct 2016, an average daily decrease to 5,078 kWh.

Through improved operating methods and updated system programming, the Georgia Archives became much more efficient through decreased kWh use. While maintaining a stable building environment, set point parameters remained unchanged for the vaults. For the first time at the Georgia Archives-Morrow location, this grant project delivered an electric bill below $11,000 monthly charge. We are now completing the commissioning test and balance and will continue saving electricity in the future, striving to achieve an annual reduction of 25- 30% kWh.

PROJECT ACTIVITIES AND ACCOMPLISHMENTS

Research determined that collections could tolerate wider swings in temperature and relative humidity than previously believed. Large organizations began testing cost-saving measures such as reducing fan speeds, installing variable frequency drives (VFDs), replacing lighting, and conducting controlled shut-downs. The Georgia Archives experience suggested the future for many cultural institutions. The challenge was to provide a stable building environment while controlling operating cost and increasing sustainability. Efficient use of energy, water, and other resources underscored overall environmental stewardship.

While measures such as these continued to be tested by more institutions, they were not widely implemented for more sustainable buildings and balancing green technology with updated environmental controls. Professionals in the preservation field had struggled to ensure that difficult environmental measures were met within set-point parameters and with less emphasis on costs or environmental impact. In the face of diminishing availability and surging cost of energy resources, the profession explored more efficient methods of achieving the best environment for collections while balancing concern for costs and the current energy crisis.

For several years, the Georgia Archives was able to significantly reduce energy usage while continuing to maintain vault set points of 65 F (+/– 5 F) and 35% RH (+/– 3%) to ensure the preservation of collections. Tested procedures of adjusting set points, raising chilled water temperatures, and controlling shut-downs included careful documentation and monitoring using PEMs and *eClimate Notebook*, consulting with experts, conducted research, and participated in training. Unfortunately, energy costs climbed about 41 percent, making it necessary to find further energy reductions. Through the NEH grant program, this became an opportunity to be responsible collection stewards and reduce the impact upon the natural environment by implementing sustainable and permanent energy savings measures. With the awarded grant funding from NEH, further automation of the HVAC system continued the energy savings measures begun years ago by the Georgia Archives staff. At the same time, these measures provided thorough documentation useful to many cultural institutions with the following:

1.) ***Installed variable frequency drives***

Installing VFDs was done for each of the vault AHUs (IV – 4V) and for the AHU serving the conservation and scanning labs (AHU-2S) in order to modulate fan speeds, especially during

nights and weekends. The AHUs that served the four storage vaults were operating at constant volume and full power, 24 hours each day. The fans speeds were not adjustable, which resulted in over-pressurizing the vaults, problematic as vault doors were only opened to retrieve records. The pressure built in the vaults and expended valuable energy.

These factors contributed to over-operation, increased maintenance costs, and excess energy usage. Though informative, manual shut-downs were labor intensive and difficult to sustain with limited staff, requiring manual monitoring of the system around the clock. Installing the variable frequency drives allowed fan speed adjustment and continued automation shut-downs. We were able to program a setting so that the AHUs decreased power at night and on weekends when usage or outdoor temperatures are low. This increased efficiency, reduced wear and tear on equipment from overuse, and further conserved energy. There was no risk or damage to the collections because of the tests and tolerance levels, which were established in consultation with—and monitored by—the Archives preservation staff.

Variable frequency drives cannot operate without static pressure sensors; these needed to be installed, as well. A static pressure sensor was necessary for each of the five variable frequency drives. The sensors were located in the supply and return duct work. These required monitoring and regulation of the VFDs, dependent upon the pressure readings, temperature, and relative humidity readings. The VFDs and static pressure sensors were installed by the original mechanical contractor for the construction of the building.

All four vaults received a VFD and associated controls. It was necessary to add some additional parameters to simplify temperature and humidity controls. A dehumidifying control language was added to initiate reheating at the units. This provided backup control of set points in case the dehumidifier failed. Setting VFD speeds from 55 percent to 95 percent range also provided language to lock-in VFD speed if outside air conditions are stable. With this, temperature and humidity levels stabilize at +/- 3 points; previously, we were +/- 10-15 points on all issues.

2.) *Updated control system*

The original building computer control system was designed by Honeywell in 1998, operating on Windows NT, UNIX, or Windows 2000 platforms. Our version of the control system was no longer supported by Honeywell, though, and it only functioned on a dial-up connection. The control software required an upgrade for internet-accessibility, including the purchase of a new computer, updated software, and a programming contractor to link to the Georgia Archives mechanical system. As cost-share, the Archives provided the computer server necessary to operate this integrated control system.

The new system is a Windows 8.1/10 Niagara/Tridium/Schneider Electric GUI. It may be updated via the internet and monitored by email, cell phone, and automated text messages. The new system is accessible through Firefox or Internet Explorer. New graphics and equipment are easy to understand with graphics displaying all set points for humidity, temperature, and pressure variables.

3.) *Recommissioning of upgraded systems*

Once all of these updates were implemented, a professional vendor recommissioned the five air handlers (four that serve the vaults plus one that serves the laboratory areas and processing rooms) as well as the two dehumidifiers. This was a necessary step to ensure optimal

operation. Recommissioning is a thorough process of checking and balancing design modifications and functionality of a system. It ensures that all systems are operational, meeting and maintaining all design specifications.

The vendor hired a certified recommissioning agent to check environmental conditions and verify that everything is functioning as designed. Work was performed by a firm certified by the National Environmental Balancing Bureau (NEBB) and/or the Associated Air Balance Council (AABC) in testing and balancing disciplines for this type of project. It was completed under the direction of an Engineer licensed in the State of Georgia. At the end of the recommissioning, the Archives received a report, performance certificate, and warranty for two years, a process requiring four to six weeks to complete**.**

Recommissioning of the new automation system has been divided into two areas, cooling and heating seasons. All upgraded equipment was checked and verified to be working as intended. A new sequence of operations has been developed for all upgraded equipment to overlay the original design. Each commissioning provided a detailed punch list of issues that needed to be done per season. Dampers were tested and balanced at each vault unit, including DH-1 and DH-2 chilled water, hot water, and *cubic feet per minute* (cfm) of air going to each vault unit.

4.) *Installed integrated boiler system*

Controlling the relative humidity in the conservation lab and exhibit room had proven to be difficult and expensive in these important areas which frequently house original documents. Maintaining a constant relative humidity in the conservation lab is critical when performing treatments that require slow-drying adhesives. The exhibit room was designed to have very similar environmental conditions to that of the vaults but was never equipped with humidification for use during the winter. Environmental monitoring data indicates that the relative humidity fluctuates in winter well below acceptable levels; it can dip into the low 20% range. IPI research specifies that collections should not be stored in areas with a relative humidity below 30%.

By installing a fully-integrated boiler system for the building, staff could tightly regulate the relative humidity especially affecting these two critical spaces and thereby minimize energy use. Installation of a new Fulton steam boiler was completed. It is updated and able to maintain demand for new temperature, humidity, and safety controls. With very little lag time between demand and supply pressure, the new system is less than 10 months old and already 25% more efficient than the previous model.

5.) *Established lighting upgrades*

Upgrades became necessary in the reference library and original documents reading rooms. The cold cathode/neon lights installed into the square soffits in the ceiling of these two areas, while excellent for their low UV output, were extremely expensive to maintain and operate. Furthermore, the neon lights used a significant amount of energy, especially upon start up when the ballast converts 120 volts to 990 volts. For this reason and security purposes, the lights remained on continuously. As they failed, each neon lamp cost nearly $400 to replace. Replacing the fixtures and lamps with low UV fluorescent lighting greatly decreased energy costs, maintenance, and replacement bulbs, while also reducing the use of rare earth elements (in the neon lights), damaging to the environment. The cost of replacement LED lighting was too expensive, so these lamps were replaced with LED bulbs, using the same fixtures.

The Georgia Archives requested grant funding with the offer of contributing an equal portion as cost-share to convert lighting and fixtures to more energy efficient, lower maintenance LED lighting, specifically for the Archives areas where original material exists or were used. These areas included the exhibit spaces, original document reading areas, reference library, conservation, and reformatting labs where grant funding allowed for lighting upgrades.

The impact on the collections during the work on the five air handling units and lighting upgrades was minimal. Collections did not have to be relocated or moved at all, since the mechanical systems are located adjacent but not inside the storage vaults. Since the air handlers had to be shut-down during installation of the VFDs, this was scheduled to minimize the impact on collections. One VFD was installed at a time, and only one AHU was off at one time. Staff anticipated a six hour shut-down period for installation and linking the VFD to the existing AHU. Work was timed to take place during the coolest hours of the day, as well. The lighting upgrades were scheduled to take place on days when the reading rooms are closed, and any collections in those areas were protected and covered with plastic sheeting.

PROJECT PLAN AND SCHEDULE

Before the Grant Period Began:

- Continued manual AHU shut-downs when outdoor temperatures were below 80 F. The Georgia Archives economized through automation and could only save money by shutting-down equipment whenever possible.
- Continued to use PEM2s to monitor conditions in all vaults, reference, processing areas, and the conservation lab.
- Track energy use using utility online accounts.

Throughout Grant Period:

- The grant project members continued to meet frequently, including:
  Chris Davidson, State Archivist
  Steve Engerrand, Deputy State Archivist
  Adam Parnell, Assistant Director of Operations
  Kim Norman, Preservation Services Manager and Conservator
- Data collection and analysis continued during installation of the variable frequency drives and static pressure sensors, requiring the air handlers to be disengaged while adjustments were made to the environmental control system. Vigilant monitoring was required during the upgrades, but no collection materials needed to be moved. Environmental monitoring data from the PEMs was collected as possible during the upgrades, tracking energy usage and overall monitored data during this time.
- Project progress was disseminated by Archives staff members over Year Two and Year Three of the grant cycle. Presentations during state, regional, and national conferences highlighted sustainability issues that surfaced as staff supervised building system upgrades.

Year One—*Oct 2012 to Sept 2013*

- Sought bids for all outside work on the upgrades to the air handling units (AHUs) and recommissioning
- Sought bids for computer software to operate new and existing equipment (include custom programming and installation)
- Monitored costs/tracked usage of electricity and gas during warmer months for reference
- Began drafting white paper

Year Two—*Oct 2013 to Sept 2014*

- Upgraded lighting installation took place gradually during hours when the Archives was closed to the public, specifically Mondays and weekends
- Monitored systems and conducted cost-savings analysis during cooler months.
- Adjusted sequence for operations of drives
- Comparisons for energy savings from AHU and lighting upgrades
- Created PowerPoint presentations to disseminate project progress and successes
- Presented project findings for regional, state, and national conferences
- Continued drafting white paper

Year Three—*Oct 2014 to Sept 2015*

- Presented project findings for regional, state, and national conferences
- Completed lighting upgrades initiated during Year Two
- Continued drafting white paper

Year Four—*Oct 2015 to Sept 2016*

- Installed variable frequency drives on all five AHUs
- Installed static pressure sensors in air handlers
- Installed environmental control system (computer and software)
- Recommissioning HVAC system with professional testing and balancing firm
- Comparisons for effectiveness of new boiler system equipment, analyzing energy savings from decreased steam boiler usage
- Comparisons estimating energy savings from upgrades
- Completed drafting white paper and final financial report

GRANT PROJECT TEAM

Christopher M. Davidson, J.D., Assistant Vice Chancellor/State Archivist
Christopher holds a J.D. from Jones School of Law, a Master of Liberal Arts (Southern Studies), and Bachelor of Arts (History) from Auburn University Montgomery. He has been State Archivist of Georgia since 2012 with more than 22 years in archives and records management in Alabama and Georgia as well as university-level teaching experience. Christopher built and oversaw the Archives and Records Management Office at the Alabama Department of Archives and History. While there, he oversaw the daily operations of the State Records Center and worked directly with state agencies on records management. In Georgia, Christopher has overseen the State Archives as it transitioned from the Secretary of State to the University System of Georgia, giving numerous presentations and workshops on a variety of topics.

Kim Norman, Preservation Manager and Conservator
Kim holds a B.A. in Sociology (Economics) from Sweet Briar College and MFA in Book Arts and Printmaking from The University of the Arts in Philadelphia. She has been affiliated with the Georgia Archives since 2006 and a staff member since 2013 where she is responsible for managing preservation activities, conservation treatments, and digital reformatting. Kim actively participates in ESF-11 training with GEMHSA (Georgia Emergency Management and Homeland Security Agency) for statewide and regional emergency preparedness. She serves on the AIC Sustainability and Emergency Committees, the steering committee of the Atlanta-area *Alliance for Response* team (HERA), as the current President of the Southeastern Regional Conservation Association (SERCA), the past Co-Chair of the AIC Emergency Committee, and the past Secretary for the Society of Georgia

Archivists. Kim is an adjunct instructor at Valdosta State University instructing Belizean students in Preservation and Disaster Awareness classes. She presents often during meetings and workshops on a variety of conservation and preservation topics. For this NEH grant project, Kim served as project manager, ensuring that the grant team adhered to schedule while assisting with budget management and completing all required reports. Kim worked closely with the State Archivist and Assistant Director for Operations, contributed to data tracking, and presented project findings.

Adam Parnell, Assistant Director for Operations
Adam has been the Assistant Director for Operations at the Georgia Archives since 2006. He has been in the Facility Management field for over 30 years. Before joining the Georgia Archives, Adam was a staff member of the Emory University Facilities Division for 15 years, working in Automation, Energy Management, HVAC, and laboratory fume hood design. Prior to working at the Archives, Adam was the Chief Engineer for General Electric Realty Properties, managing properties in the Atlanta area such as Atlanta Plaza, Resurgens Plaza, Sanctuary Park, and various properties in the Southeast. Other positions include Fulton Co Parks and Recreation, Army Corp of Engineers, U. S Army, Post Properties, and TAB services, an Atlanta-area Test and Balance firm. He holds an Unrestricted Conditioned Air License, the State Stationary Engineer's license, and has a Certificate of Authority on boilers and low voltage wiring with the State of Georgia. Adam is certified to manage many proprietary systems including Trane, Carrier, York, General Electric, Mitsubishi, Munters, Johnson Controls, Siemens, Automated Logic Corporation, and Honeywell. He coordinated all of the mechanical work for this grant project, obtaining and evaluating vendor bids, and purchasing necessary supplies. Adam oversees the recommissioning of all system upgrades, co-authored this grant proposal, and served on the original Environmental Monitoring Team.

Steven W. Engerrand, Deputy State Archivist
Dr. Steve Engerrand has a B.A. from University of Wisconsin-Madison, an M.A. from North Texas State University, a PhD in History, University of Georgia, 1981 and a MLn, Emory University. He has extensive experience as an archivist and records manager and has university-level teaching experience. As an archivist, Steve has accessioned, appraised, processed, and described records and private papers. He has been responsible for preservation, reformatting, and description as well as for selecting and cataloging published materials. Steve coordinates Archives purchasing with the University System of Georgia, co-authored this grant proposal, and served on the original Environmental Monitoring Team.

PROJECT CONTINUATION

The Georgia Archives staff anticipates these energy saving measures will continue to be successful as the results outlined in this report are assessed in the future. Installing the variable frequency drives and updating the control system allowed for fan speed reductions at times of the day when it was previously impractical to manually make such adjustments. The system now works much more efficiently and effectively, further reducing energy usage and equipment damage without adverse effects to the Archives collections. Lighting upgrades throughout the building demonstrate a great impact on energy saving as well as lower maintenance costs, also without comprising the preservation of the collections. Staff members document these savings through continued monitoring of environmental conditions and tracking utility usage.

FORMAL PRESENTATIONS AND PROMOTIONS

During the four-year grant cycle, Archives staff proposed and presented these NEH grant project findings to many conferences, including the Southeastern Museum Conference (SEMC)-*Successes with Grant Projects*, the American Institute for Conservation (AIC)-*Sustainability Session*, the National Association of Government Archives and Records Administrators (NAGARA), and the Georgia Archives-*monthly public presentations*. Staff will conduct one more presentation during 2017 at the Georgia Archives and will continue to incorporate project results into future presentations. As often as possible, the Georgia Archives will continue to proudly share information about the results of this successful grant project, helping other organizations that may be facing similar issues.

LONG-TERM IMPACT

It is understood that many institutions face similar circumstances as the Georgia Archives, considering the conflict of balancing pressures to reduce operating costs while continuing to protect collections. With a complex HVAC system and state-of-the-art facility, the proposed and implemented upgrade measures are not out of reach for organizations with smaller or less complicated building systems. Many cultural organizations with older systems would benefit from upgrades with VFDs.

Others repositories would benefit from seeing an organization demonstrate that such energy saving measures can be employed incrementally by taking a systematic approach. Institutions will be able to plan for and justify their own implementations of similar strategies with this data in hand.
To this end, the Georgia Archives continues in the unique position of serving as a model for other organizations striving for sustainable stewardship while balancing pressures to reduce energy usage in their facilities. We encourage others facing similar challenges to apply for NEH Sustaining Cultural Heritage Collections Implementation Grants, striving for improved and sustainable preservation.